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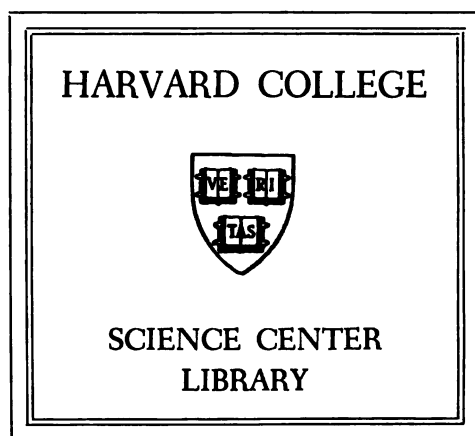
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Hewitt. On the statistics and  
geography of the production of  
iron. 1856.

Chem 7238.56







ON THE  
STATISTICS AND GEOGRAPHY

OF THE  
PRODUCTION OF IRON :

A PAPER READ BEFORE THE AMERICAN GEOGRAPHICAL AND  
STATISTICAL SOCIETY, ON THE 21st FEBRUARY, A. D.  
1856, AT THE NEW YORK UNIVERSITY.

BY  
ABRAM S. HEWITT,

AND  
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1856.



**American Geographical and Statistical Society,**  
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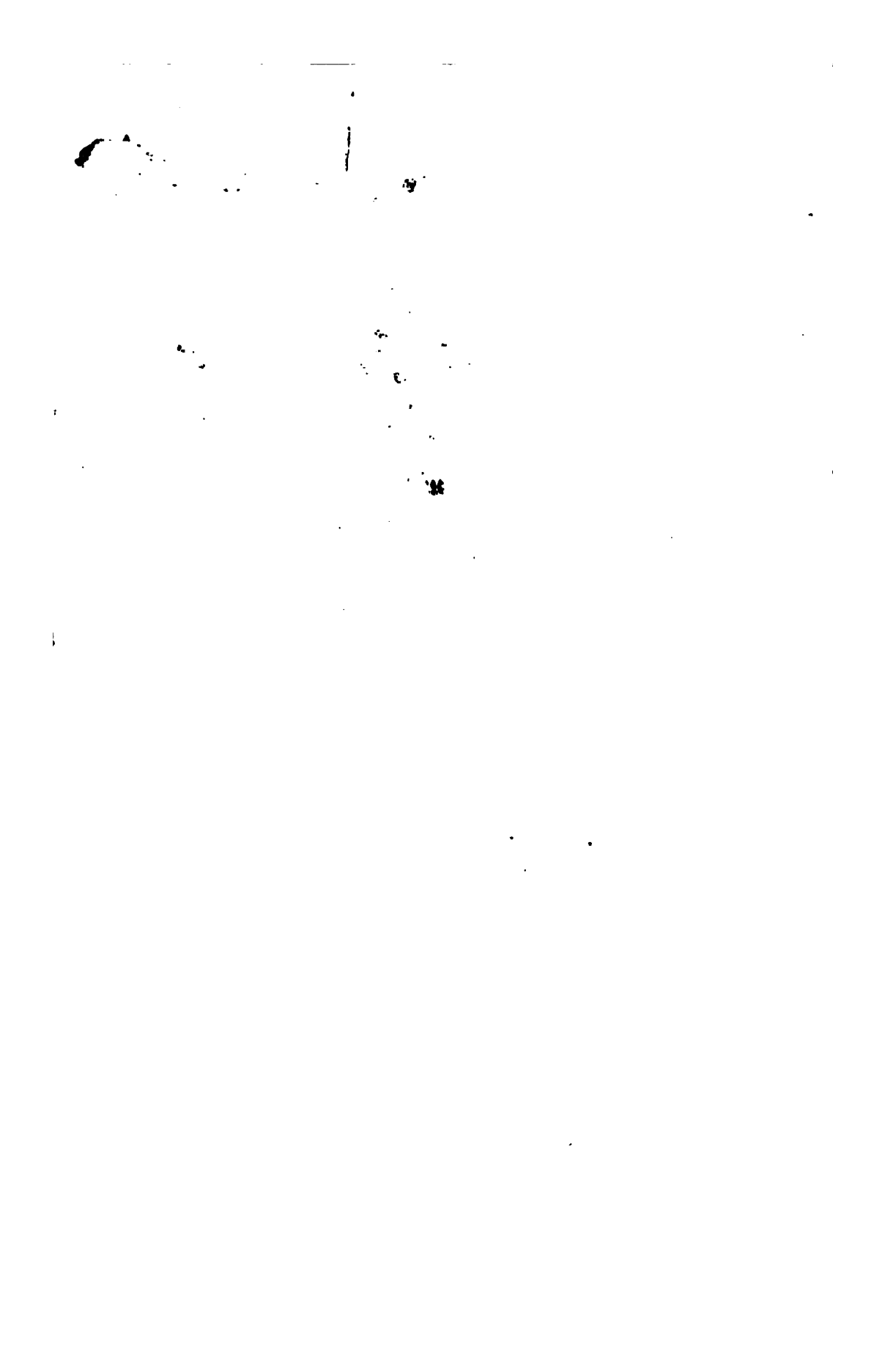
At a meeting of the Society, held at their rooms this evening—

HENRY GRINNELL, Esq., V. P., in the Chair,

The Society proceeded to the paper of the evening; upon the conclusion of the reading of which, by Mr. HEWITT, the Hon. HORATIO SEYMOUR offered the following resolution, which was unanimously adopted:—

*Resolved*—That the thanks of the Society be tendered to Mr. HEWITT for his very able paper read before the Society this evening, and that a copy be requested for publication, for the uses of the Society.

WM. COVENTRY H. WADDELL,  
*Recording Secretary.*







*Received  
of  
S. V. Stragnick  
New York.*

## ON THE STATISTICS AND GEOGRAPHY OF THE PRODUCTION OF IRON.

A PAPER READ BEFORE THE AMERICAN GEOGRAPHICAL AND  
STATISTICAL SOCIETY, ON THE 21<sup>ST</sup> FEBRUARY, 1854.

MR. PRESIDENT AND GENTLEMEN OF THE SOCIETY :

One of our poets has told us that Basil, the blacksmith, was

"A mighty man in the village, and honored of all men;  
"For, since the birth of time, throughout all ages and nations,  
"Has the craft of the smith been held in repute by the people."

How far this feeling of respect for my calling has weighed with you in honoring me with a request to prepare a paper on iron, I know not; but it is quite certain that from the earliest days there has been a peculiar charm about the business, which has left its traces in the myths of the ancients, and in those mystical legends of the middle ages, that have survived the decay of empires and feudal institutions, and even to this day delight the young at the Christmas fireside.

In one of the earliest treatises on alchemy, we are told how the "Sons of God," who first fell from their high estate through love for "the daughters of men," imparted to their giant offspring the secrets of extracting the metals from the earthy calx; and who of us have forgotten with what intense interest our childhood was absorbed in those wonderful stories of King Solomon, in which this race of genii are represented as toiling, imprisoned in the bowels of great mountains, to produce the metals which enriched the wise king, and enabled him to build

the Temple of God, "so that there was neither hammer, nor axe, nor any tool of iron heard *in* the house while it was in building."

Nor is it strange that to the young or the ignorant, the idea of magical power should attach to those who, penetrating into the depths of the earth, shatter the mighty rocks with explosive power, rivaling the thunderbolts of Jove, and by the combined action of earth and air, and fire and water, reduce from the dull ore the glowing vivid metal, till then

"In stony fetters fixed and motionless."

It is a perpetual struggle against resisting nature, and the victory is only won by turning her own gigantic powers against herself, so that the ancients called in the aid of Gods to account for the triumph; and for the gift which, as *Æschylus* has it, "has shown itself a teacher of every art to mortals, and a great resource," made the unhappy *Prometheus* expiate the offence in fetters on the rude Caucasian rock.

But in our day the interest which attaches to the production of iron rests upon a better appreciation of the difficulties to be surmounted; and upon a full knowledge that iron is the main-spring of modern civilization, *Locke* has told us that "he who first made known the uses of iron may be truly styled the Father of Arts, and the Author of Plenty;" and in our own day, *Hood* thus wittily sums up its multifarious applications:—

"The universality of the employment of iron is so manifest, especially in this country, that if any period has deserved the title of the Iron Age, to none can it be so characteristically applied as to the present. The seas are traversed by iron ships; the land travelled over by iron carriages upon iron roads. We have iron engines employed for nearly every mechanical purpose. Water is brought along our streets by iron pipes, and all our thoroughfares illumined by means of gas conveyed to us through a similar channel. Many of our houses have iron floors and iron roofs, whilst the windows are closed with iron shutters. In short, from the gigantic steamer which crosses the Atlantic, to the smallest of ornamental shirt buttons, this metal has become so prevalent, that the country ought to be ticketed, like a

laundress' window, with 'Ironing done here.' But the wealth and comfort arising from this state make it equivalent to the much more lauded advantages of the Golden Age."

The hand that penned these characteristic words was scarce cold in the grave before that great temple of industry, reared like a creation of magic, had been opened in the metropolis of the world, to receive the products of every clime, and exhibit the fruits of human ingenuity to admiring thousands. Fond enthusiasts dreamed that the reign of universal and perpetual peace had been inaugurated, and that the material which had been used for dealing out death and destruction was now for evermore consecrated to human progress, and a higher civilization. But scarce had the last notes of the national anthem died in the ears of the heterogeneous mass of hearers who were assembled from all nations and tongues of the earth to witness the magnificent closing of the most magnificent spectacle which mankind has ever seen, when the rude alarm of war burst upon astonished Europe; and all the energy, skill, and genius of the world were called into play to devise new methods of applying iron to the work of destruction. Steamers hurried masses of men and supplies with a speed which throws the achievements of Napoleon into the shade. A railway is constructed from the sea to the beleaguered city; the steam-whistle shrieks its wild requiem over the dead and dying as it conveys them by the car load to hospitals, sanctified by the holy and heroic presence of woman. The telegraph carries the swift messages of death, from the entrenched camps to the cabinets of ministers, a thousand miles away. The tidings of victory or defeat are heard by a listening world before the great cannons have ceased to roar. For days and weeks together, the mouths of these gigantic monsters vomit forth iron hail, until walls are battered down by the resistless shock of twenty thousand tons of cannon balls; and the stern old Russian, who had stood unmoved while he lost his thousand men a day, is compelled to retire before what he graphically describes as "the fire of hell." It is the terrible energy with which iron has been employed in this contest, rather than any skill in strategy or diplomacy, which now enables the world to felicitate itself with the prospect of peace after the lapse of two short years, instead of having to endure

all the miseries of a struggle protracted for thirty years, as in all former European contests. But my limits on this occasion do not permit to trench on the domain of the moralist, nor even of the man of science. My investigation will have reference solely to the statistics and geography of the production of iron ; and if, as I fear, the results be found dry, and lacking in originality, my apology must be found in the name and objects of this Society, and in the consideration, so well stated by another, "that statistics are far from being the barren array of figures ingeniously and laboriously combined into columns and tables, which many persons are apt to suppose them. They constitute rather the ledger of a nation, in which, like the merchant in his books, the citizen can read, at one view, all the results of a year, or a period of years, as compared with other periods, and deduce the profit and loss which has been made in morals, education, wealth or power."

And first, I shall attempt to give you a succinct account of the growth of the business. Iron was known to the ancients ; but being the most difficult of the metals to reduce, it came into use after the other metals were well known. Tubal-Cain is admitted to have been the first manufacturer ; but on so small a scale was his business established, that even in the days of Homer, a piece of iron which a single man could throw was offered as the most precious prize at the games in honor of the death of Patrocles.

" Let him whose might can hurl this bowl, arise :  
Who farthest hurls it, takes it as his prize."

When Porus came from the land of gold and pearls and diamonds to propitiate the conqueror of the world, it is recorded that his most precious gift to Alexander was a piece of Indian iron weighing forty pounds. In the days of Pliny it had come into more general use ; and he is equally eloquent in describing its application in the arts of peace, as he is indignant at its perversion to the purposes of war. But it was not until long after the Christian era that its production was aided by any mechanical appliances worthy of the name. It is exceedingly doubtful whether cast-iron, (carburet of iron,) was known until the 13th

century after Christ. Previous to this time, iron was made by simply placing the ore and charcoal in layers in a rude oven, and smelting it by a blast forced in by a common bellows, worked by the hand of man.

We are accustomed to regard the crusades purely as an outburst of religious enthusiasm at a time when the civilization of the world afforded no outlet for the pent-up energies of men, and to attribute to them no other practical result than the impoverishment of the nobles, and the consequent liberation of the serfs. But it is probable that the returning crusaders brought back with them the knowledge of the manufacture of cast-iron, thus identifying the birth of modern civilization with the birthplace of that divine religion which has accomplished for the moral elements of our nature what the use of iron has for the practical progress of the race.

The knowledge thus acquired was soon put to use throughout Europe; but it surprises the inquirer to find that in the year 1740, only 116 years ago, the total production of iron in England amounted to not more than 17,350 tons, made by fifty-nine furnaces, giving an annual production of 294 tons to each furnace. At that time I am satisfied that the total production of Europe did not exceed 100,000 tons, of which 60,000 tons were made in Sweden and Russia, and one-half of this was imported into England. The annual consumption of iron in England was, therefore, 15 pounds per head of population, and in Europe did not exceed 2 pounds per head. The destruction of wood, caused by this insignificant product, was so rapid, that the business of making iron was likely to be extinguished, when, as is the universal rule, the evil which was dreaded gave birth to a remedy which imparted new life to the production, and has enabled it to reach its present gigantic proportions. This remedy was the substitution of pit, or *mineral* coal, for charcoal. To Dud Dudley, an Englishman, is due the merit of this discovery, or at least of its practical application; and to him, more than any other man, belongs the title of the "Father of the Iron Trade." But his discovery made little progress for the period of 100 years. In 1750 it came into general use; and in 1760 the first blowing cylinders were erected by Smeaton, at the Carron Iron Works. A single furnace was there made to yield 1000 tons per annum, or

three times as much as the average of charcoal furnaces. This wonderful result agitated the whole industrial world, so that even the poet Burns came to see the grand spectacle; and being refused admission, gave vent to his indignation in these rather indiscriminate lines:—

We cam na here to view your warks,  
 In hopes to be mair wise;  
 But only lest we gang to hell,  
 It may be nae surprise.  
 But when we tirl'd at your door,  
 Your porter dought na bear us;  
 So may, should we to hell's yetts come  
 Your billy, Satan, sair us.

[A. D., 1797.]

The total production of Great Britain, in 1788, had reached 68,300 tons, making an increase of 50,950 tons in 48 years, *i. e.*, 300 per cent. At this time Watts' great invention of the steam-engine was introduced; and emancipating the iron works from dependence on sites where there was water power, produced so great an increase in the business, that in 1796 the production had reached 125,079 tons, and in 1806, only 10 years later, it had increased to 258,206 tons, each furnace making an average of 1546 tons per annum; but the average of the best constructed was 2615 tons per annum, or nine times as great as the charcoal furnaces only 60 years before. At this date, only 50 years ago, I am satisfied that the annual make of the whole world did not exceed 500,000 tons, one-half of the present annual production of the United States. The annual consumption of iron per head in Great Britain had reached 40 pounds, showing conclusively a wonderful progress in the arts of civilization—the consumption having nearly trebled in less than 60 years.

These were the results of the inventions of Dud Dudley and of Watts. But in 1783 and 1784, Henry Cort, also an Englishman, inaugurated a new era in the iron business, by his invention of the process of puddling (*i. e.*, of converting cast-iron into wrought iron in reverberatory furnaces), and of reducing the rough masses thus obtained into finished bars, by grooved rollers. The history of this great benefactor of his race is an instructive one. Born to a competence, well educated in the science of his day, attracted to the iron business by an enthu-

siasm which no obstacles could daunt, he devised two improvements, so essential, that it is not too much to say that the iron business could not exist without them—that railroads would be impracticable—that iron ships could not be built—because the wealth of the universe would not be adequate to the production of iron on a scale now rendered essential by the wants of civilized life. He expended \$250,000 in putting his invention into practice ; he proved its merits ; he built works for himself and others, which were eminently successful ; he had licensed a production which would inevitably have produced to him one of the largest fortunes which human ingenuity has ever achieved, when his associate, a deputy paymaster in the navy, was proved to be a defaulter to the extent of £27,000, the patents were seized by the British Government ; but instead of being prosecuted, were kept tied up with the usual red tape, in the office of some government official, “without the slightest benefit either to the state or the patentee,” so that the fruits of a life of honest labor were lost, and Cort was reduced to beggary—a monument of the sad results, on the one hand, of a breach of official trust, and on the other, of official routine and delay. William Pitt finally accorded to him a pension of £200 per annum, which he lived to enjoy for six years, dying broken-hearted, and the British iron trade generously raised £1000 for the relief of his widow. And this was the temporal reward of one, the immediate results of whose inventions have been summed up by an abler hand than mine, as follows:—

“In 1782, the total quantity of British hammered iron exported did not exceed 427 tons. In 1854, the total quantity of pig iron exported was 293,074 tons ; puddled and rolled iron, 883,237 tons ; to which, if one-third be added for waste in conversion, the real quantity exported will be 1,177,649 tons—total British iron exported, 1,470,723 tons.

“In 1782, the total make of British hammered bar iron did not amount to 10,000 tons—too inferior in quality for exportation beyond 427 tons. In 1853, the total make of puddled and rolled iron was very little short of 3,000,000 tons, which, at the cost of foreign iron previous to 1783 and 1784, averaging, exclusive of duty, £40 13s. 4d. per ton, would be not less than £92,000,000



sterling; whereas, by puddled and rolled iron, at the average cost not exceeding £10 per ton at the most, it has cost only £30,000,000 sterling, thus saving in one year £62,000,000 sterling, as compared with foreign bar iron; being all made out of materials previously useless, and by British labor. For the last 66 years, including money less paid to foreign countries for bar iron, and more received from them for 8,000,000 tons of British puddled and rolled iron, besides 17,000,000 tons for home consumption, extra profits to the iron manufacturer, £37,000,000 sterling, and profit to the mineral owners at least £12,000,000 sterling, the whole saving to the country is equal to £300,000,000 sterling, besides feeding and clothing four generations of workmen and their families, or more than 600,000 people for sixty-six years. These are the services of Henry Cort.\*

I have detained you too long from the main subject; but less I could not say, without being treacherous to the memory of a man to whom justice has never been done.\*

Since the time of Cort, with the exception of the introduction of the hot blast, in 1829, and of the use of anthracite coal in 1837, of which I shall have occasion hereafter to speak, no material improvement has been made in the modes of making iron, and in 1806 all the processes were in use which now prevail in the best constructed works. The growth of the business was thenceforth very rapid, limited only by the consumption of product.

In 1818, the product of Great Britain

was estimated at.....300,000 tons.

" 1820,	"	.....400,000	" (Mushet.)
" 1823,	"	.....452,066	" (official.)
" 1825,	"	.....581,367	"

At which date the yield of each furnace averaged 2,228 tons, being an increase of 45 per cent. in 19 years, chiefly due to improved machinery, larger furnaces, and better blasts.

In 1830, the annual make was 678,417 tons. The use of the hot blast now enabled raw coal to be substituted for coke, by which the consumption of coal was largely reduced, *i. e.*, from 8 tons 1½ cwt. to 2 tons 13¼ cwt. for making one ton of pig iron

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\* I have since learned that a subscription is on foot in England for the benefit of Cort's descendants.

in Scotland, to whose ores and coals it was found to be chiefly applicable. As the present make of Scotland is now over 800,000 tons, the annual saving in coal is nearly five millions of tons, or about the quantity mined on the Atlantic slope of the United States. It is worthy of note that Neilson was compelled to enforce his patent by legal process against the combined strength of the trade; and it was only after years of vexatious delay that his patent was affirmed on appeal to the House of Lords, and that he received the reward of his great discovery. It is recorded that the Bairds, the princely proprietors of the Gartsherrie Works, and who, from being day-laborers in a coal mine, have achieved their present position as the makers of over 100,000 tons of pig iron per annum, and as the richest manufacturers in the world, settled Neilson's damages for infringement, by a check on the Bank of England for £150,000 sterling. So marked was the effect of this discovery, that

	In 1836,	the make	amounted to	1,000,000 tons.
	" 1839,	"	"	1,248,781 "
	" 1840,	"	"	1,396,400 "
	" 1845,	"	"	1,512,500 "
<i>official.</i>	" 1847,	"	"	1,999,608 "
	" 1852,	"	"	2,701,000 "
<i>(Truran)</i>	" 1854,	"	"	3,585,906 "

Made by 599 furnaces, giving an average to each of 6,000 tons, being over  $2\frac{1}{2}$  times the yield of each furnace in 1825. This incredible product was achieved by the direct labor of 238,000 men, and 2,120 steam-engines, of an aggregate power of 242,000 horses, and the value of the gross product was \$125,000,000. If you will pause to consider the infinite variety of uses to which this iron has been applied, for it was all consumed at least six months ago, you may perhaps be able to form some idea of the millions of human beings whose labor it has absorbed, and to whom it has given bread, especially when I tell you, (I quote the *British Quarterly*), "that a bar of iron, valued at \$5, worked into horse shoes, is worth \$10 50; needles, \$55; penknife blades, \$3,285; shirt buttons, \$29,480; balance springs of watches, \$250,000;" all of which increase in value is given by the application of human labor.

To make this product, and reduce rather more than half of it to bars, there were dug from the bowels of the earth, and consumed—

12,346,000 tons of iron ore,
2,450,000 " " limestone,
20,146,000 " " coal.

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Tons.... 44,942,000

A sum total before which the imagination stands appalled.

I am inclined to believe that the production for 1855 did not materially exceed the figures for 1854. Even the British lion pauses to take breath; but it is rather from the difficulty of providing materials on short notice, than from any unwillingness to supply the world with all the iron which is wanted for its annual consumption. I shall now endeavor to ascertain what that amount is, by succinctly stating the make of other European countries, as nearly as I can ascertain the same.

	Date.	Tons.
England .....	1855.....	3,585,906
France .....	1845—438,900 tons, estimated	650,000
Belgium .....	1855.....	255,000
Russia.....	1849-'51—191,492 estimated.	300,000
Sweden.....	1850-'52—124,169 "	157,000
Norway .....	1855.....	22,500
Austria .....	1847—165,776.....	200,000
Prussia .....		400,000
Balance of Germany.....		200,000
Elba and Italy.....		72,000
Spain.....		27,000
Denmark, and balance of Europe.....		20,000
United States.....		1,000,000
		<hr/> 6,889,906

The present annual production of the world does not, therefore, exceed 7,000,000 tons, of which Great Britain produces rather more than one-half.

Assuming the population of the world to be 900,000,000, the

production, and of course the consumption, is at the rate of about 17 pounds per head.

In 1740, when we have the most reliable data, the consumption of iron did not amount to one pound per head. But the great fact to which I wish to call your attention, in order to deduce the practical results at which this paper aims, is the distribution of the present consumption among the nations of the world. In order to determine this point, I have made very careful calculations, which show the following result:—

Nations.	Production per head.	Consumption per head.
England .....	287 lbs.	144 lbs.
United States.....	84 “	117 “
France .....	40 “	60 “
Sweden and Norway, 92	“	30 “
Belgium .....	136 “	70 “
Austria .....	12½ “	15 “
Russia .....	10 “	10 “
Switzerland.....	— “	22 “
Prussia .....	50 “	50 “
Germany, Zoll Ve-		
rein, .....	50 “	50 “
Spain.....	4½ “	5 “

Turkey, and the uncivilized portions of the world, too little to be calculated.

A careful examination of this table will demonstrate conclusively that the consumption of iron is a social barometer by which to estimate the relative height of civilization among nations; for considering in what practical civilization consists (I exclude æsthetic civilization from this species of estimate), measuring by the actual comforts and conveniences with which social life is surrounded, what philosophic traveller, or student, will not classify the nations of the world precisely as the table arranges them: England first, United States second, Belgium third, France fourth, Germany fifth, Switzerland and Sweden about on a par, Austria next, then Russia, Spain, and Turkey, and the great outlying regions of barbarism?

You will not fail to observe another fact, that the large consumers are large producers in every case,—a fact which a little familiarity with the laws of trade and industry will show to be inevitable.

It is plain that the consumption of iron is rapidly on the increase, as well from the progress in the arts of life as from the increase of population, and the steady march of Christianity and civilization, like twin-sisters, into the regions of barbarism. This consideration has an important practical value in determining what future demand will be made upon the iron-making resources of the world; for, if it were as highly civilized as Great Britain, mankind would consume as much iron per head, viz.: 144 pounds, which would make a total annual consumption of about sixty millions of tons, or nearly seven times the present product.

How much time will be required to bring the world to such a degree of civilization, it is not for me to decide; but it is apparent that when it reaches this point the annual consumption of iron will be over one hundred millions of tons; for it is to be remembered also, that the annual consumption per head is increasing; that in 115 years it has increased seventeen fold. If the next century should show the same result, the consumption would be 300 pounds per head, requiring an annual make of 140,000,000 of tons.

But the population of the world is rapidly increasing, and in 100 years will probably be nearly doubled, which would raise the consumption to over 200,000,000 of tons per annum. I am aware that common sense stands appalled before these immense figures. Previous to this investigation, I have never allowed myself to look the facts in the face, and I am therefore desirous to submit them to the severest examination. Let me ask you, therefore, to measure the future carefully by the past.

From 1740 to 1855, the production of iron increased seventy fold. If the same rate of increase should prevail for 115 years to come, the annual make would reach 490,000,000 of tons, and it is to be observed that the ratio of increase has been an increasing one for each period of ten years since 1740, and not a decreasing one. Commencing with 1806, it required till 1824, a period of 18 years, to double the production in Great Britain.

By 1886 it was again doubled, requiring a period of only twelve years. In 1847 it was again doubled, requiring eleven years. In 1855, a period of eight years, it had risen from 2,000,000 to 3,500,000, at which rate it would double in ten years.

Now, if the production of the world were to double only once in twenty years, the make, in

1875, would be.....	14,000,000
1895,       " .....	28,000,000
1915,       " .....	48,000,000
1935,       " .....	96,000,000
1955,       " .....	192,000,000

Figures, again, so enormous as to defy any man of common sense to stand before you and say that they will be realized. And yet, if any one had ventured the prediction in England in 1740, when the make was 17,850 tons, not so much as the yield of the establishment with which I am connected, that in 115 years the make would reach  $3\frac{1}{2}$  millions of tons, he would have been regarded as a lunatic, and told that all the men, and all the wealth, and all the mineral resources of Great Britain were not adequate to one-fourth of such an incredible production. Allow me to apply a further test to this matter. In Great Britain there is one mile of railroad to about eight square miles of surface. In Connecticut the ratio is about one to six. In the State of New York the ratio is about one to twenty. The habitable world would not be ever supplied with the conveniences for travel and transport if one mile of railroad were built for each ten square miles of surface. Now, according to the best authorities, there are 20,000,000 of square miles of habitable surface on the globe, which will ultimately require 2,000,000 miles of railroad. To lay and operate this quantity will require 600,000,000 of tons of iron, the annual wear and operation of which will demand at least 60,000,000 tons per annum. The consumption for railroads now absorbs about one-third of the make of iron; and it is apparent that while the use of iron for purposes for which it has been long applied is daily growing, each year brings forward new applications which seem to indicate that there is no practical limit to its use.

View the subject, then, as we may, whether by the history of the production of iron for the last 100 years, or by considering the consumption per head and the progress of civilization, applying only the law which we find at work, and which no social Joshua has power to arrest, we are brought to the conclusion that, great as is the present production of iron, it is but in its infancy, and that the very smallest amount which will answer the purposes of the civilized world 100 years hence, will be 100,000,000 tons per annum. How and where, geographically considered, is this enormous quantity, or the half of it, or the quarter of it, to be made?

In order to solve this problem, it is necessary to consider what are the elementary conditions essential to a large production of iron. These are—

*First.* An adequate supply of the requisite raw materials; ore, limestone and mineral coal; for charcoal can only be used as we have seen, to an insignificant extent.

*Second.* These raw materials must be geographically so situated as to be brought cheaply together, for the value of raw material does not more consist in what it is, than in *where* it is—a fact too much overlooked in the mining projects of the day.

*Third.* There must be cheap means of transport to market.

*Fourth.* There must be sufficient density of population to insure labor at a moderate cost.

*Fifth.* There must be adequate capital to build and carry on the works.

*Sixth.* There must be the skill to manage them in the most economical manner.

*Seventh.* There must be indomitable energy and strict integrity in the management; that is to say, the iron business can only exist on a large scale where the people are essentially industrious, intelligent, energetic and honest.

You perceive that these elementary conditions are either natural, moral or artificial. They are all combined in a remarkable degree in Great Britain. The local distribution of the business, even within its narrow limits, has been determined by some or other of these conditions. The coal and ore and limestone are very generally interstratified throughout the island. Its small extent and insular position have made the combination of natural and artificial means of transport cheap and rapid. The people are hardy, intelligent, and singularly honest and persevering; their peculiar commercial and colonial policy, stretching to the utmost confines of the globe, for more than a century has made London the centre of the financial world, and consequently insures a large supply of capital at the lowest rates; the requisite skill and development of the mineral resources have been obtained by a century of experience, when foreign competition was religiously excluded by prohibitory duties, until England could make iron cheaper than all the world, and since then domestic competition has cheapened the processes and reduced the cost to the lowest practicable limits consistent with the maintenance of an adequate supply of skilled labor, which the aristocratic features of the government, and the small area of the island, have alike contributed to furnish at the bare cost of the necessities of life; and withal the climate is free from great extremes of heat and cold, and favorable to the use of stimulants, which are supposed to be essential to those engaged in a business which demands at the same moment considerable intellectual vigor and great muscular strength.

Other nations, as will be seen, possess equal natural and moral resources; but in none at this day exist in such perfection all the artificial conditions which are essential to a large production of iron at the lowest possible cost. But there is a natural limit beyond which an adequate supply of raw materials cannot be cheaply procured; beyond which each additional ton makes all the other tons cost more; and there is a limit beyond which the demand for labor will raise its price. Moreover, the advantages which England possesses in the way of capital will not last forever, when the two continents are only ten days apart, and the extremities of the globe are pouring gold into the lap of each, as from two gigantic cornucopias, gilded



one by the rising and the other by the setting sun. Other nations are striving to open up their resources and improve their domestic channels of communication, in order to enable industry to achieve its triumphs more cheaply, and thus lessen the disparity which now gives Great Britain so large an advantage.

Whenever, then, the increasing iron consumption of the world reaches a point which overtakes the natural resources of Great Britain, in way of raw materials and labor, it is evident that it will cost her more to make iron than it now does. It therefore becomes a very interesting question to other countries, especially to their legislators, and those engaged in the iron business, to determine whether Great Britain has reached or is approaching a limit when the demand will be large enough permanently to raise the price, so as to permit other countries to engage in the business without the aid of artificial stimulants to production. The enormous increase in the make of Great Britain, within the last three years, has had the effect to double the price of coal and ironstone, and the advance in the wages of labor has been very decided. The consequence has been that the Russian war, and the financial troubles of last year, have had no perceptible effect on the price of iron. The price would have fallen but for the fact that the cost of production would not admit of any material reduction. In other words, owing to the increased pressure for coal and ore and labor, it has cost much more per ton to make three and a half millions of tons last year, than it cost per ton to make two millions of tons eight years ago. I do not wish to be understood as saying, that even with the present demand Great Britain cannot undersell the world. Far from it: she can do so. But I do wish to say, that if the addition of a million of tons to the demand has doubled the prices, the addition of another million to the demand would have a decided influence in still further advancing them; and that at length, in the progress of the world, a point would be reached beyond which the required iron could not be supplied at all.

Now, the facts and considerations I have enumerated would indicate that this period is not very remote. If so, it becomes interesting to inquire from what quarter of the globe the surplus is to come in the main. I think I shall be able to satisfy

you that but one country can fulfill the required elementary conditions, and that country is the United States.

In the first place, the Anglo-Saxon race,—which, by the way, has an extraordinary faculty of incorporating all other races, and still retaining its characteristic features,—alone combines the moral elements essential for the business. The French have great acuteness and unrivalled taste; the Germans have steadiness of purpose and frugality; but for downright courage and steadfast perseverance, steady economy and patient industry, mechanical ingenuity and ever-improving skill, strict integrity, and a high sense of accountability, all combined in one people, you must go to the Anglo-Saxon race in the old world, or its offshoot in the new.

In regard to the natural elements, I am ready to admit that abundance of iron ore exists in all parts of the world, scattered by the bountiful hand of a gracious Providence, as if to indicate that in case of necessity no nation should be without the means of independence for the essential element of progress, if such independence becomes desirable. In the United States this is particularly the case. But abundance of iron ore does not suffice for the *cheap* production of iron. Mineral coal must be also abundant and easily accessible. In order to indicate the relative position of the leading nations of the globe in this respect, I have copied a diagram from Taylor's great work on coal, showing the available areas of mineral coal in each country—by which it appears that the United States stand first upon the list; that out of 184,073 square miles of coal area, our country has 133,132, or nearly three-fourths the whole amount, and sixteen times as much as Great Britain and Ireland together. It is to be observed, moreover, that this coal exists in nearly every State in the Union, or where it does not exist, it is readily accessible to the main deposits of iron ore in the non-bearing coal States. At the most important localities for the purpose of making iron, immense bodies of coal exist above water level, whereas in England it has to be mined and raised from the depths of the earth. Measuring by the coal areas, and iron ore being equally abundant, it is the true standard, the United States can produce fifty millions of tons per annum with as little drain on

its natural resources as Great Britain can produce 3½ millions ; and in this connection it is essential that a most important fact be noted. I have stated that to produce 3½ millions of tons in Great Britain required the consumption of 45 millions of tons of raw materials, or about 13 tons to each ton of iron. In the United States, from the greater richness of the ores, and the more general use of anthracite coal, the same result could have been achieved with less than half the quantity of raw materials, thus economizing labor to an enormous extent. In point of fact, the materials for making a ton of iron can be laid down in the United States at the furnace, with less expenditure of human labor, than in any part of the known world, with the possible exception of Scotland.

In regard to our present and prospective means of communication, I need not attempt to enlighten a Geographical Society how far we surpass all other countries in our great rivers and greater lakes, in our 4,800 miles of canals, and our 23,000 miles of railway, more than are possessed by all the world beside, and in our steady addition to them of 3,000 miles per annum ; all forming a length of intercommunication so vast, that "distance literally lends enchantment to the view."

Endowed with these moral and natural elements to an extent unsurpassed by the most favored nations, it may well be demanded why we are not the largest producers of iron in the world ; why the domestic iron trade is affected with a kind of periodical catalepsy ; why our ironmasters have been perpetually knocking at the doors of Congress either for relief, or immunity from further legislation. By one portion of the community they have been regarded as importunate beggars for charity from the public crib, and by another portion as "rich nabobs," who desire a perpetual monopoly of a prosperous business. In behalf of these hypothetical beggars and putative nabobs, I crave your indulgence while I make answer, and I think myself fortunate that I am permitted to do so before a body who will pass judgment on the explanation in a calm and philosophic spirit.

✓ In 1740, when the English iron trade began its wonderful career, this country was a comparative wilderness. A hardy population, scattered along the seaboard, barely succeeded in

conquering for themselves the means of livelihood. The resources of the country were unknown, and no roads existed into the interior, nor was there any capital to be spared for the erection of works, from the resources of a community struggling for existence. Skilled labor was not to be found among a race who had quitted their ancient homes from a stern sense of duty at a time when operatives were proverbially ignorant and brutish. Notwithstanding these difficulties, the manufacture of iron took root; and as factories for the working of iron in the colonies were strictly forbidden by the mother country, the pig iron was chiefly exported to England, so that for the year 1771 the amount reached 7,525 tons. When the revolution broke out, the country was in a condition to supply the iron required for the great work of freedom; but so little capital existed, that the Continental Congress were forced to take up the business of iron-masters, and make in New Jersey chiefly the iron and steel required for the army.

By the close of the war, England had entered upon the full tide of success in the manufacture of iron by the use of mineral coal. Capital, skill, and labor abounded; while here all was distress; the currency deranged by the unmanageable flood of continental money, and exchanges made by the rude process of barter. The advance of the nation from a condition of bankruptcy, with its resources all undeveloped, was painfully slow;—while in England, each year added to its resources, its skill, and its ability to withstand and crush competition. But the United States could be no competitor, using charcoal against mineral coal. It was not even known at the beginning of this century that we had any coal that could be rendered available for this purpose; and when our great resources in this respect began to be understood, there were no avenues to market from the coal-fields. These avenues have since been constructed; but at what an enormous outlay of energy, capital, skill, and dogged resistance to obstacles of every kind, those who are familiar with the history of the Schuylkill Canal, the Reading Railroad, the Lehigh Canal, the Delaware and Raritan, the Chesapeake and Ohio, the Delaware and Hudson, the great State works of Pennsylvania and New York, will alone be able to comprehend. The outlay for this purpose, which had to be

made before the iron business could be said to have a chance of existence in this country, probably exceeded one hundred millions of dollars; and it was not until 1840 that the first furnace was successfully started and worked with anthracite coal, which in England was regarded as entirely inapplicable until 1837, when Mr. Crane first demonstrated that it could be used.

The application of this fuel, which has given life to the American iron industry, and enabled it to bear up against the embarrassments which at times have threatened its existence, originated, as most great discoveries do, in a difficulty which was supposed to be insurmountable. The works of Mr. Crane were located at the lower edge of the Welsh bituminous coal-fields, and at the verge of the anthracite deposits. Having exhausted his available deposits of bituminous coal, he had to choose between abandoning his operations and the use of anthracite. For a long time his efforts to use this fuel were abortive; when, sitting in his room late one night, it occurred to him that when a stream of cold air was blown upon a lump of red hot anthracite, a black spot appeared, and the combustion was extinguished. The same coal placed in a grate, with a blower on it, causing a draft of cold air, would burn with intense heat. It suddenly flashed upon him that this phenomenon was due to the heating of the air as it pressed through the ignited mass of coal. In his joy at this discovery, he summoned from his bed his assistant, David Thomas, Esq., the present manager of extensive anthracite furnaces in this country, and announcing his solution of the problem, proceeded at once to test it, by placing a coil of iron pipe in a mass of flaming bituminous coal, and forcing through the pipe, with a common bellows, a current of cold air, was delighted to find that as it issued highly heated from the other end of the pipe, it no longer destroyed the combustion of the anthracite, but on the contrary promoted it in a marvellous degree. From this day the economical use of anthracite for making iron was achieved; and yet, four years before, a resident of New York, remembered by many of you, Frederic W. Geissenheimer, had patented this identical process; but no use had been made of it, because the disastrous results of all attempts to establish the manufacture of iron on our soil on a large scale had discouraged the most sanguine. But after Crane's success,

new efforts were made; and it is to be recorded to the honor of Nicholas Biddle, that he was among the first to contribute his money and his influence to the successful prosecution of this business. To another of our New York citizens, Edwin Post, Esq., who brought great intelligence, capital, and indomitable perseverance to the task, is due the honor of having first smelted successfully our rich magnetic ores with anthracite coal, at Stanhope, N. J., as he has since succeeded in reducing the Franklinite, heretofore believed to be entirely refractory.

From the time of the application of anthracite coal, the historian will date the birth of the American iron business. Its great density and purity fit it peculiarly to our rich ores; so that while in England, with three years the start of us, the product of anthracite iron had reached only 140,000 tons in 1855, in this country it amounted to at least 360,000 tons; showing that, where an approach to an equality of the elementary conditions can be realized, there are lacking in this country neither energy nor skill to take advantage of the opportunity to achieve a successful result.

But the artificial impediments which stood in our way at the outset,—I mean the dearth of capital and labor invariably incident to a new country,—did not cease to exist with the opening of the necessary channels of communication, and the discovery of a new fuel for smelting. They did indeed enable us to place together the raw materials required to make a ton of iron at as low a cost, notwithstanding the higher price of labor, as they could be procured in Great Britain. But they could do nothing towards reducing the cost of smelting them afterwards; for this being done solely by the application of dearer capital and dearer labor, necessarily made the product more expensive. Many enterprising men, overlooking this consideration, and doubtless led astray by too clear a perception of our superior natural advantages, and relying upon the continuance of the duties imposed by Congress upon foreign iron, until the domestic production could compete successfully with it, by reason of the removal of the only obstacles to its success, dearer labor and capital—many such men, I say, staked their fortunes, and devoted their great energies to the establishment of the business here upon a scale not unworthy of their British prototypes. An

examination of the diagram of American production will show succinctly what these men or their successors deriving title in most cases through the sheriff, have accomplished.

In 1810 the production of iron, entirely charcoal, was 54,000 tons.

In 1820, in consequence of the commercial ruin which swept over the country just before, the business was in a state of comparative ruin, and not over 20,000 tons were produced.

In 1828 the product was 130,000 tons.

In 1829       "       142,000 "

In 1830       "       165,000 "

In 1831       "       191,000 "

In 1832       "       200,000 "

In 1840       "       315,000 "

In 1842 it fell to less than 230,000 tons, the result of the remission of duties under the compromise tariff.

In 1846 Secretary Walker estimated it to be 765,000 tons, the result of the combined action of the high tariff of 1842, and the high prices in England, caused by the new demand for railways.

In 1847 and 1848 it reached 800,000 tons.

In 1849 it fell to 650,000 tons.

In 1850, by the census returns, it was reduced to 564,755 tons; and it continued to fall off until the first of January, 1853, when the whole product did not exceed 500,000 tons, still leaving it, even at the lowest point, second only to Great Britain. The make then began to increase, so that in 1855 it had reached at least one million of tons.

These strange mutations of productions are susceptible of a clear explanation. I have stated that iron costs more to make in the United States than in Great Britain, only because capital and labor are dearer here than there. Bearing this in mind, it is evident that the difference of cost may be obliterated whenever the demand for iron is so great that the price rises sufficiently in England; or when the price is low, by the imposition of a heavy duty on the importation of English iron.

From 1842 to 1846, the latter cause will explain the increase

of the domestic make; but it does not explain why, under the tariff of 1846, the make should increase for two years to 800,000 tons, then recede to 500,000 tons; then advance again to 1,000,000 tons, presenting a make equal to that of Great Britain only 19 years ago.

The fluctuations in the price of iron will alone explain this phenomenon, and as this is the only serious difficulty in the way of the permanent success of the American production from this day henceforth, I have prepared a diagram, which will give you some idea of the nature and extent of the fluctuations in the price of iron, a staple article, and more uniform in the actual cost of production than any article of manufacture. This diagram presents the price of common English bar iron in Liverpool, every three months, since the year 1806, when, as you will remember, owing to the general introduction of the improvements of Dudley, Cort, Watt, and Smeaton, the make began rapidly to increase, and the price to fall.

It is an established social principle, that the make of an article will increase even on a falling market, so long as it pays a profit.

An examination of the diagram, and of the diagram of production in Great Britain, will show clearly how great the profits must have been, or the economies introduced, to permit iron to fall in price, as it did, \$45 per ton, in the 16 years, from 1806 to 1822. This great reduction in price will show why the American iron trade was utterly crushed in 1820, with no adequate duties to shut out the foreign product. But the low price in England, and the falling off in production in this country, soon created an additional demand, which raised the price in England, and revived the manufacture in America. By the natural law that production will outstrip demand, when the profits are large, the price soon began to fall again in England, and ruin was only averted from the American product by the black tariff of 1828.

The great speculations and railway projects of 1836 again carried prices up; which, falling again under the influence of increased make, brought ruin again to our domestic production, no longer having any defence under the compromise tariff of Mr. Clay.



The tariff of 1842, imposing substantially a prohibitory duty, simultaneously with a largely increased demand in Great Britain, caused by low prices, stimulating consumption, and followed by the railway mania of 1844, again raised prices to a high point, and re-established our domestic manufacture. The commercial disasters which followed the railway speculation in England, and the famine of 1848, again reduced prices in England, and the American production was cut down one-half, because, under the *ad valorem* tariff of 1846, low prices are accompanied by low duties. But this time it is to be observed that the make did not get below 500,000 tons, showing that anthracite pig iron could hold its own, even with the low duties. If no duties had been imposed, I must declare my solemn conviction that every furnace in America must have been closed, because, for three years, every hour of which I remember, it was a struggle for life, and not for profit.

In 1852 the railway system in Europe and this country was again prosecuted with vigor. Prices of iron advanced in England; the manufacture here became prosperous, and it is a remarkable proof of the elastic nature of our people and our resources, that the make of iron has doubled in four years, whereas in England it has never doubled in less than ten years. If you will examine carefully so much of the diagram as covers the last 30 years, during which time the cost of making iron has not much varied, you will observe that the extreme points of depression in price, which have always ruined our American iron-masters, do not continue more than one or two years. At such periods the selling price is below the cost of manufacture even in England. But herein lies the advantage of capital. The English iron-master is either rich enough to hold his product for better prices, or can borrow money at low rates on it; while here the maker must sell at a loss, or stop his works—either of which is ruin. If the American maker could hold his product, he knows that remunerative prices cannot be long deferred.

The increase of capital in this country, and especially in the hands of the iron-masters, will overcome one of the artificial advantages which the English have heretofore possessed over us. At present capital is unusually dear in England, and the

course of trade, and the better knowledge abroad of our resources, are doing much to equalize the value of capital, and to remove one of the most serious difficulties in the way of the progressive growth of our domestic manufactures.

But at the periods of low prices, the English maker does not require so much capital, because his labor is cheaper, and his iron therefore costs less.

Is there any reason to expect that this remaining artificial difficulty in our progress will be removed in like manner as that of capital is disappearing? The question of the cost of labor is a complex one, depending upon many elements, which the limits of this paper forbid me to investigate. It is apparent that the nature of the currency and the density of the population, will have great weight in fixing the nominal or current rate of wages. Heretofore, and at the present time, the influence of both these elements have been and are against us. With a currency made up chiefly of paper, we have been competing with nations whose circulating medium has been composed chiefly of the precious metals. It seems to me that the recent extraordinary addition of gold to our domestic resources is doing much to relieve this difficulty; and if the addition be steadily continued, and especially if there is a corresponding effort made to restrict the circulation of paper money, or if such restriction be the result of natural laws, a very great difficulty will be removed from our industrial progress, so far as the question of foreign competition is concerned.

In regard to the other element, the density of population, it is apparent that every day is making its influence less and less disadvantageous to us. The annual rate of increase in the population, taking the average of the censuses since 1790, is  $8\frac{1}{10}\frac{1}{10}$  per cent. per annum in this country, while in Great Britain it is only  $1\frac{4}{10}\frac{3}{10}$  per cent., or only one-sixth of our ratio of increase. Again, in regard to density of population: In the middle States, which must necessarily be the chief seat of the iron business, the population in 1790 did not exceed 5 to the square mile, whereas in 1850 it had reached  $57\frac{7}{10}\frac{3}{10}$  to the square mile. The present density of population in Great Britain and Ireland is  $225\frac{1}{10}\frac{2}{10}$ , a great difference it is true, but one which the more rapid increase of our population is steadily reducing.

It is certain, however, that within the last ten years the disparity in the wages of labor in the two countries has been greatly reduced, not by any fall in the price here, but in the increase of the price in England. And it would seem reasonable to anticipate that, with the present rapid and cheap intercourse between the two continents, an equalization in the rewards of human industry would inevitably take place, and every step towards such an equality is in favor of our production of iron on terms of equality in every respect.

It is apparent, then, that the only reason why iron *now* costs more to make in this country, is the greater value of capital and labor, and that there are natural laws at work, slowly but surely sapping at the roots of these obstacles. But it may be alleged that it will require too long a time to equalize these conditions, and that it is better to abandon the business now, and wait till these desirable changes have actually been realized. To say nothing of the ruin which this course would entail upon those who are now engaged in the business, and who have nursed it to a condition where it no longer requires the aid of any duties beyond what the revenue of the General Government demands; to say nothing of the loss of skill and machinery, which twenty years of sacrifice would not replace; I think that another natural law is at work, which will soon place us beyond the aid of tariffs or the fear of competition; a law which, overcoming the extra cost of labor and capital, insures to us that iron will be produced here at an early day as cheaply as it can possibly be got from Great Britain, even if entire free trade be allowed. If such be the fact, to discriminate at this time against the iron trade, to deny to it the revenue duties which are imposed upon other articles of import, would be the height of folly; for the business would be ruined, and the country would save no money and vindicate no principle by such legislation.

Let us see what this law is. I have been at great pains to trace the increase of the consumption of iron by the world, and to form an accurate idea of its future demands. I have called your attention to the fact that, even now, the resources of Great Britain have been so taxed to meet the existing demand, as to increase *the cost* of iron, (I do not mean the price,) because the

miners are driven to less favorable localities to procure adequate supplies of raw material. If the production of  $3\frac{1}{2}$  millions of tons per annum has made each ton cost more than it did when the production was only two millions, the addition of another million must have a corresponding effect. But the world will want and must have the other million, and two of them, and three of them, and, unless other countries aid in the supply, the price will rise far above our present cost of production. It seems to be the inevitable conclusion of the facts I have stated, that this day is not far distant. Even now we can make iron at the *average price* of English iron, and if we made none, that average price would be higher; so that there is no reason to believe that iron would be sold for less than it now is if it all came from England. But let it be noted that the American iron-master now asks for no special legislation in his behalf; but he objects to any legislation, and very properly, which excepts him from whatever incidental advantage there may be in the fair imposition of duties for revenue. Heretofore, in times of great depression, long continued, he has felt the want of financial or legislative corks to float him over these "sloughs of despond;" and it is at such times, and such only, that you have heard him, a drowning man, conscious that he has many years of life in him, if he could only touch a bouy for a short period, calling on Congress for temporary relief, or entreating that the slight prop between him and ruin might not be knocked away. Now, however, he feels that the steadily increasing demand of the world for iron, and the fact that England cannot supply the whole of it without a decided increase in cost, insures to him that soon, aside from the question of capital and labor, these periods of extreme depression will either cease to occur, or, if recurring at all, will continue for such short intervals that he can sustain himself till the improvement takes place. But there is reason to believe that we are on the eve of another discovery, which will reduce the cost of making wrought iron in this country by intermitting the process of reducing the ore into pig iron, and then converting it into wrought iron. If we can succeed in making wrought iron direct from our rich ores, the whole cost of coal and labor in the blast furnace will be saved. Professor Wilson refers to this matter in his official re-

port to the British Government on our iron-making resources, and again, in his able paper, read subsequently before the Society of Arts, expresses his decided opinion in favor of its practicability. My space forbids enlarging on this topic; but it offers another reason why the iron trade should not be singled out at this juncture as the victim of special legislation to its disadvantage.

I have been thus careful to show that at this day the possession of adequate skill, of extensive and properly constructed works, of a large body of intelligent workmen, of great natural resources in the way of raw materials and channels of communication, and of equally great ones in the canals and railways which the genius of our age and people have constructed, makes legislation for the purposes of protection no longer necessary, because I regard the days of protection, for the sake of protection, as passed away. I have been equally careful to show that the artificial elements of dearer labor and capital do not make us independent of a fair share of those duties which are necessarily imposed for the raising of national revenue, but that there are causes at work which promise soon to make us independent even of this aid, to which we have a fair claim in the balance of national interests; because, under this state of facts, intelligent and influential men, identified with our great railway interests, have combined together in the short-sighted policy of demanding a remission of the duties on railroad iron at a time when it has been demonstrated, and is admitted by all experienced engineers, that our American rails are more durable than the foreign rails, and consequently worth more by the whole amount of duty paid. They have made this movement at the very time when the facts and probabilities all favor the conviction that the steady approach to the equalization of the elementary conditions of cost in the two countries will soon place us on a par with our only competitors. I am anxious to have the exact nature of this proposition clearly understood, and to contradistinguish it from the old contest between the principles of free trade and protection. In 1846, the advocates of protection insisted that iron should be made an exception to the general principle that duties should be levied only for revenue, and that a special duty should be imposed upon foreign iron, in

order to protect our domestic manufacture. The advocates of free trade denied that this could be done either upon sound principles or under the Constitution, and that the most that could be done was to place iron in the schedule which included other staple articles of consumption. An effort was then made to make railroad iron free; but it was firmly resisted by Mr. Walker, and the other consistent advocates of free trade, as being just as much subversive of the revenue principle, as to impose protective duties in favor of iron. The iron-masters conformed to the principle; and after a long struggle, in which many fortunes have been lost, have succeeded in placing the business on a firm footing. The effort now is to single out the iron business, and make it an exception to the general principle, and discriminate *against* it, so far at least as a leading branch of the industry is concerned. That this movement did not succeed last year was chiefly due to the firmness and intelligence of the present Secretary of the Treasury, who refused to lend his sanction to any measure of discrimination against the iron business; and to his adherence to sound principles is due the fact that the manufacture of railroad iron has grown, and continues to grow, in this country. As I am informed that the proposition to exempt railroad iron from duties will be again renewed this year, I desire not to repeat the conclusive arguments of Mr. Walker and others on this point, but merely to state the fact, that we can make railroad iron in this country with as much economy as any other kind of iron; that the quality is superior to that imported, and that the cost does not now exceed the *average price* at which foreign rails have been delivered in our ports. The only effect of a repeal of the duties, beyond a temporary advantage to a few local enterprises, would be the destruction of a business which has been established in our soil, under great sacrifices, but *in strict conformity* to the well-settled principles upon which our revenue is raised. Ten years ago no rails were made in the United States. In 1855, we made 135,300 tons, and imported only 127,516 tons.

In 1851, we imported 188,625  $\frac{1}{2}$  tons of rails.

" 1852,	"	245,625 $\frac{1}{2}$	"	"
" 1853,	"	298,995 $\frac{1}{2}$	"	"
" 1854,	"	282,663 $\frac{1}{2}$	"	"

[Vide Treasury Reports.]

We can point with pride to the fact that we have passed the half-way point ; and if the business is not struck down by legislation expressly levelled at its destruction, in less than two years we shall be able to supply the entire wants of the country.

Having thus traced the progress of the trade in this country, and shown that its difficulties are only artificial and temporary, it only remains for me to investigate the geographical elements of our present make of iron, and to show in what parts of this great country are, and will be, the seats of its production.

Humboldt, in his *Cosmos*, has treated at length upon the influence of mountains, and their necessary concomitants, rivers, on civilization and the arts of life. The geographical location of the iron industry is dependent upon their influence. Our rich ores have their origin in the volcanic changes which produced the mountain ranges ; and the corresponding valleys, with the river drainage, determine the spots where the ores shall be reduced and the metal transported to market. The Hudson and Delaware, the Schuylkill and Potomac rivers, drain the valleys formed by the great range of the Blue Mountains ; while the Susquehanna, the Ohio, and the Mississippi drain the valleys formed on either side by the great Apollachian group. Still further west, the Missouri and its tributaries drain the eastern slope of the Rocky Mountains. In all these mighty valleys coal exists in boundless profusion, or is accessible to them by artificial avenues. The Hudson takes its source amid mountains filled with such incredible deposits of iron ore, that it is beyond the power of science or of numbers to compute the quantity. Lower down, its more recent formations are rich in secondary ores, especially in the valley of the Housatonic, which is part of what may be called the Hudson area. Anthracite coal has been made accessible to this region by means of the Delaware and Hudson Canal. The result is, that a large iron industry has, within a few years, sprung up on the banks of this noble river, which is destined to assume great magnitude. In 1855, the production in northern New York, in the Housatonic valley, and on the lower Hudson, between Troy and New York, must have exceeded 100,000 tons. New furnaces are building, and the resources for production are only limited by the quantity of coal, which can be procured at moderate rates. This city must

ultimately become the focus of an iron industry that will rival Birmingham.

The Delaware with its main branch, the Lehigh, reaches into the coal region. The secondary ores abound along its shores while the Morris Canal has made the great primitive ore resources of New Jersey easily accessible. Hence the earliest successful efforts to make iron with anthracite coal on a large scale occurred in this region, and from the cheapness of the raw materials, it must be the leading seat of the iron trade on the Atlantic slope. New York is the natural outlet for this region, and our far-seeing capitalists have already made provision for it by the construction of direct lines of canal and railway. The product of this region in 1855, was about 140,000 tons, including as I always do, the make of wrought iron direct from the ore.

The valley of the Schuylkill has direct communication with the coal-fields, but has to rely chiefly on secondary ores, which are doubtless abundant. Its production may be set down at 100,000 tons.

The valley of the Susquehanna has boundless resources in ore and coal, which, in 1855, yielded a product of at least 200,000 tons.

The valley of the Potomac, with equal access to coal and ore, produced about 60,000 tons.

Virginia and the remaining Southern States, with resources equally great, have made but little use of their advantages, and have produced not more than 40,000 tons.

The valley of the Ohio and its tributaries, and the valleys of the Mississippi and Missouri and their tributaries, have resources in the way of raw material, cheap food, facilities for transportation, and a local demand, which place them far above any region on the habitable globe. In 1855, western Pennsylvania, Ohio, Tennessee, Kentucky and Missouri, produced at least 275,000 and probably 300,000 tons. A century hence, when the world will require its 100,000,000 tons of iron, more than one-half of it will be produced in our great west. The traveller who passes down its great rivers at night, will be lighted on his way by the answering fires of 10,000 furnaces, so that the "ineffectual moon shall pale" before the mighty glow of human industry. The product will bind that mighty valley, with its



hundred millions of freemen, to the rest of the Union with iron bands not so durable, but typical of the fraternal patriotism of this great country, blessed by bountiful Providence with every good and perfect gift.

The hasty enumeration of what has been done in 1855, showing a natural production of not less than a million of tons, of the value, when ready for market, as pig, bars or plates, of at least \$50,000,000, proves that our iron industry has reached the same development as that of Great Britain in 1836. If our resources are as well managed for twenty years to come, we shall stand where she does now—that is, we shall make 3,500,000 of tons; and wild as some of the results at which I have arrived may seem, I do not hesitate to declare the opinion, that by 1876, we shall reach that mark.

Commercial revulsions will undoubtedly come hereafter, as they have heretofore, and check our progress; unwise tampering with the revenue laws, in favor of special interests, may cast a cloud over the horizon, and ruin those who are now in the business, to the temporary advantage possibly, and the permanent injury certainly, of the interests sought to be benefitted; but the skill is now here, the works are now built, and in the hands of some more fortunate holder, to whom they will descend at a sacrifice, and who will have the advantage which every year makes in our favor, as against foreign competition, for the reasons I have enumerated, the works will be carried on and extended, and the country will reap the reward which unwise legislation has denied to those who have heretofore engaged in this industry, and may deny to those who are now in it.

I feel impelled to this tone of remark, by way of solemn caution to those who might otherwise regard the statements of this paper as substantial reasons for investments in the iron business. The time has not yet arrived when the laws which I have developed as in being, have done their work effectually. The difference in labor and capital is not yet overcome; but it will be. A repeal of the duties on iron, and especially on rails, would go far to ruin the majority of those who are now in the business. We are steadily and rapidly approaching the point where this may safely be done; but we are not yet there.

But even this point has not been achieved without sacrifices. Many good men have fallen in the mighty contest. Of one, who brought a great mind and a great estate to this business, who, with a grasp of intellect too comprehensive for his day, took in all the great extent of the iron trade, and the demands of the world for its product, I shall not forbear to speak, although it may be an intrusion into his present retirement. I refer to Horace Gray, of Boston, whose merits and sacrifices will one day be recognized, and whose name will be recorded with gratitude when the coming historian shall trace the eventful history of what will be the greatest branch of industry in this country. I can only say that he has lived to see his ideas realized, so far as the trade is concerned, and all his enterprises successful in the hands of others—more fortunate but not more deserving than he.

But if I were to pursue this subject I should tread on the graves of martyrs, and I forbear.

The iron business has not been a successful and profitable branch of industry in this country, if measured by the rewards it has brought to those who have carried it on. In England, on the contrary, it has been the richest of the prizes drawn from the great wheel of human industry. The same destiny awaits us here. It is a question only of time, but bearing in mind the obstacles which still strew the path of our successful progress, I can only suggest to those who propose to engage in the business the couplet from *Hudibras*, as conveying a wholesome warning:—

"Ah, me! what perils do environ  
The man that meddles with cold iron!"

To those who have essayed these perils, and succumbed to them, I can only offer the barren consolation contained in the lines of another eccentric poet:—

"Have you heard that it was good to gain the day?  
I also say it is good to fail—battles are lost in the same spirit as they are won.  
I sound triumphal drums for the dead—I fling through my embouchures the loudest and gayest music to them—

Vivas to those who have failed, and to those whose war vessels sank in the sea,

And to all generals that lost engagements, and all overcome heroes, and the numberless unknown heroes equal to the greatest heroes known."

W. A. W. H. 44

And lastly, to those who have struggled thus far with doubtful success against the obstacles of insufficient means, of adverse legislation, and the thousand difficulties which assail the enterprising, I can say, in the language which Hopeful addressed to Christian, as he was sinking in the river which separated them from the Golden City,—“Be of good cheer, my brother ; I feel the bottom, and it is good.”

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The practical results which this paper offers for your consideration, are :—

1. That the United States have greater natural resources for the production of iron than any other country of the earth, in consequence of the moral elements which characterise the nation, the unlimited possession of mineral coal, the abundance and richness of its ores, and the vast system of natural and artificial avenues of transportation which traverse the land.

2. That the difficulties in the way of a large production, are purely social and artificial, viz. : the dearness of capital and labor, which obstacles are being slowly and surely overcome by the progress of the country, and the fact that the increase of consumption throughout the world will at an early day task the production of iron in Great Britain to its utmost limits, and consequently increase its cost and price.

3. That as the United States have no competitor but Great Britain, the surplus demand, over and above the power of Great Britain to supply, must be met by the United States, and that it would therefore be unwise for the national government, in order to benefit any particular interest, to adopt such legis-

lation as would discriminate against the iron business, inasmuch as it would only retard progress that is inevitable, by bringing ruin upon those who have been pioneers in establishing a great branch of national industry, especially as it is now proven that American rails can be made at the average cost of foreign rails.

4. That the growth of the business hitherto has surpassed the corresponding growth in Great Britain; and as we may be said to have commenced 50 years behind her, we are at this day only 19 years in arrear, and may, under all the circumstances, reasonably expect to overtake and pass that country in the amount of annual production.

5. That owing to the superior richness of our ores (a point which I have not enlarged upon in this paper for want of space, and of adequate knowledge,) it is probable that science will enable us to dispense with some of the intermediate processes now necessary for the production of wrought iron, and thus achieve an equality, in point of cost, with Great Britain, even before the equality in cost of labor and capital is reached. This point will require development in a special paper, and I would suggest that some gentleman of the requisite knowledge, theoretical and practical, be requested to prepare a paper on this subject.

Lastly. Considering the important influence which the wages paid to labor have upon the welfare of the laboring classes, and the successful prosecution of manufacturing industry, I would suggest that a paper, giving the past history and statistics of wages, both here and abroad, would be of great value and general interest.



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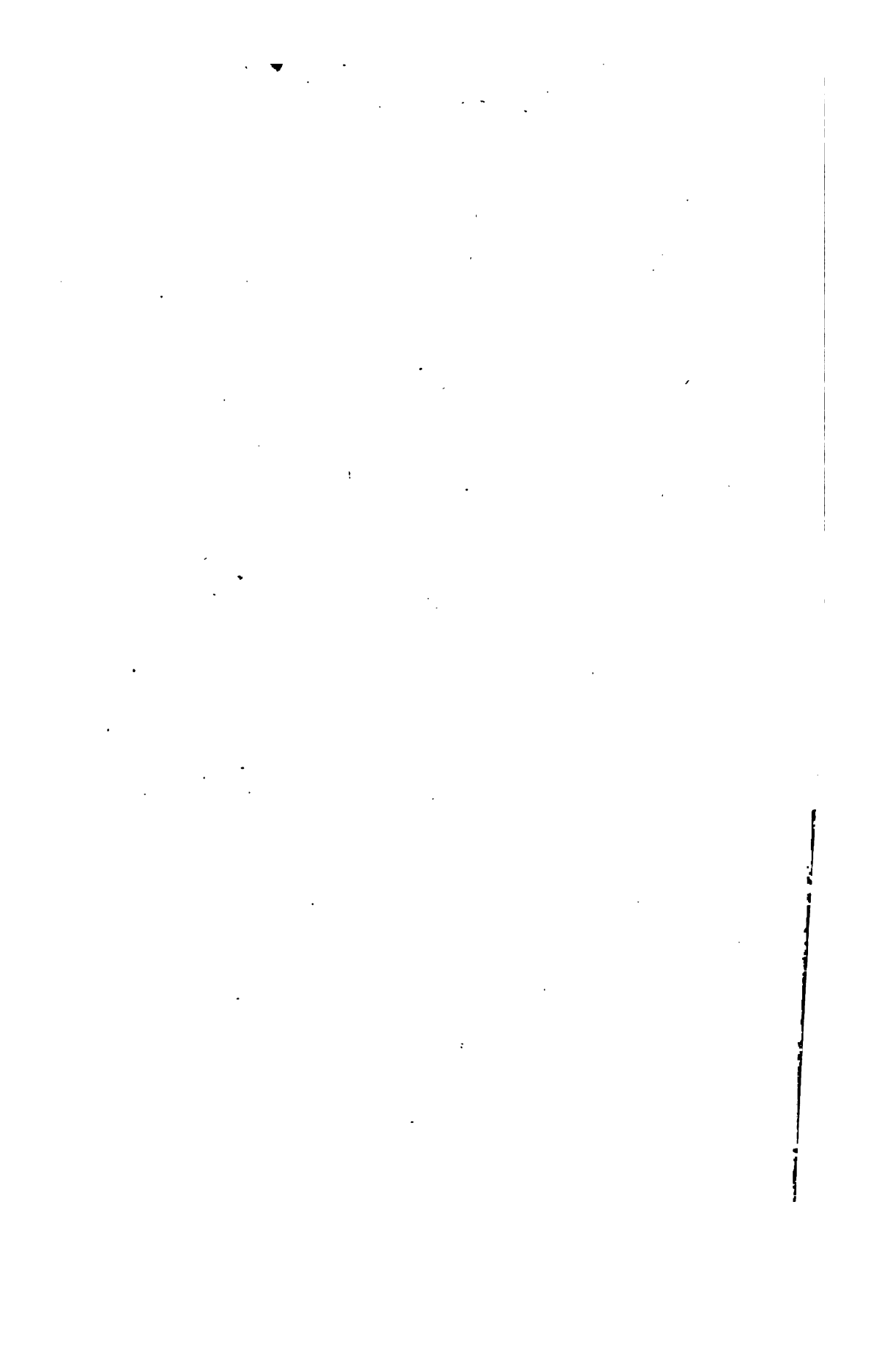
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